STUDIES IN ABNORMAL HUMAN SENSITIVITY TO LIGHT

II. Light Sensitivity in Prurigo aestivalis, Eczema solare and Urticaria photogenica

REPORT OF EXPERIMENTS

STEPHAN EPSTEIN[1]

Marshfield, Wisconsin

(Received for publication May 2, 1942)

Hypersensitivity to light in prurigo aestivalis, eczema solare and urticaria photogenica has been studied by several authors. The experimental investigation of my cases yielded additional information. Therefore, I shall present these data first, and discuss them afterward together with the findings of others.

MATERIAL AND METHODS

Special light tests were performed in 6 of the previously reported 17 cases.[2] Three were instances of non-complicated prurigo aestivalis (cases 3, 5 and 6) and one of plain eczema solare (case 10); two presented a combination of urticaria photogenica, eczema solare and prurigo aestivalis (cases 16 and 17).

Test of light sensitivity

Nearly all the tests were performed with artificial light. Mercury arc lamps were used in the form of the Kromayer and the Hanovian type, carbon arc lamps in the form of the Finsen and the Finsen-Rheyn lamps. The radiation was applied unfiltered or through the following filters: Blue uviol glass, Wood's filter and Schott's blue filter no. BG 5. The spectral regions transmitted by these filters are indicated in figure 1.

These filters permitted a clear determination of the active wave length only in some instances. The violet and blue light could be defined as the active spectral region in those cases where reactions were obtained with blue uviol and the BG 5 filter, but not with Wood's filter. Reactions elicited through uviol filtered, but not through unfiltered ultraviolet, point to the action of the longer ultraviolet or the blue-violet region. Reactions obtained by unfiltered ultraviolet only, indicate an effect of "sunburn radiation," (Blum (a)) i.e., rays shorter than 3200 A.

Some tests were carried out with other forms of radiation.

Alpha rays. Thorium X-ointment or -laquer in the strength of 1500 to 2000 electrostatic units per 1 gram or 1 cc. respectively were applied for 24 to 48 hours. This dose produced a marked erythema.

[1] From the Marshfield Clinic, Marshfield, Wis.

[2] See part I of these papers, table 1. (J. Invest. Dermat. **5**: 187, 1942.) The cases are presented here with the same numbers.

Beta rays. Mesothorium plaques, 20 mgm. radium element equivalent per square cm., filtered through 0.1 to 0.3 mm. silver.

Gamma rays. Mesothroium plaques, 20 mgm. radium element equivalent per square cm., filtered through 1.5 mm. silver.

Controls were made in all cases. Immediate urticarial reactions as well as the production of more or less prurigo-like eruptions are pathological phenomena per se. But an abnormal sunburn reaction differs chiefly quantitatively from the regular ultraviolet response. Although the "normal" reactions from the lamps and doses used were known, controls were carried out in every instance on test persons of similar age and type. It was furthermore ascertained that the effect was not due to the compression or cooling action of the Kromayer lamp.

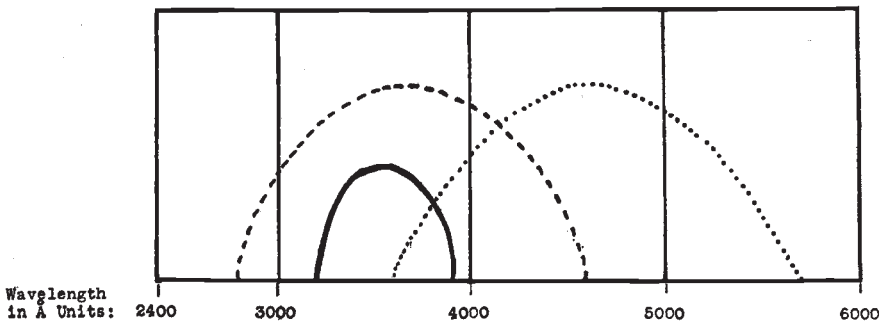

FIG. 1. TRANSMISSION OF FILTERS USED IN THE LIGHT TESTS (SCHEMATIC)
Blue uviol filter: - - - - - - - - -
Wood's filter: ————————
Schott B G 5 filter: ·····

REPORT OF CASES AND EXPERIMENTS

Case 3. Mr. G. J., 52 years, a railroad man doing chiefly outside work, suffered from prurigo aestivalis for several years. The condition affected his face, neck and the back of the hands. The eruption was somewhat atypical: it consisted of papules which were larger than those usually seen in prurigo aestivalis. They corresponded morphologically to what is known as "prurigo à grosses papules" (see fig. 3 of part I). (J. Invest. Dermat. **5**: 187, 1942).

Exposure of previously diseased skin, like the jugular triangle, to natural sunlight provoked pruritus and follicular redness after one-half to one hour. It was followed the next day by an exacerbation of other previously affected areas.

The results of the light tests are presented in table 1.

Conclusions of light tests in case 3. 1) No urticarial reactions were provoked. 2a) Hypersensitivity to unfiltered ultraviolet. 2b) Hypersensitivity to uviol filtered mercury arc light.

The patient's response was somewhat different from the ordinary "sunburn." It was of a more bright red color and showed from the beginning swelling around the follicles (see fig. 3). With longer exposures, this erythema would appear as

TABLE 1

Light tests in case 3

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULTS		
					I Immediate reaction	II Sunburnlike reaction	III Provocation of prurigo like eruption and delayed reaction
1 6-6-35	Kromayer lamp	None	15 seconds, contact	Ultra violet, violet and blue light	None	Mild spotty erythema	No delayed reaction
2 6-6-35	Same	None	30 seconds, contact	Same	None	Bright red, spotty erythema, covering nearly all of the tested area. Swelling of follicles	Transition of follicular swelling into follicular lesions on 4th day. See fig. 2, top. Disappeared after one more week
3 6-6-35	Same	None	1 minute, contact	Same	None	Bright red erythema with general and follicular swelling	Transition into confluent follicular dermatitis. See fig. 2 bottom. Healed after about 2 more weeks
4 6-6-35 Two experiments	Same	Blue uviol	10 minutes, 5 and 10 cm. respectively	Long ultra-violet, violet and blue light	None	Slight follicular erythema	No delayed reaction
5 6-6-35 two experiments	Same	Same	10 and 15 min., contact	Same	None	Bright red follicular erythema maximum between 24 and 48 hours	Same
6* 6-11-35 Two experiments	Same	Same	20 and 30 min. respectively, contact	Same	Pruritus after about 30 min.; after 45 min. sharply outlined bright red erythema	Erythema persists, increases in intensity; general and follicular swelling. See fig. 3; after 48 hrs. follicular swelling more pronounced	Gradual transition from erythema into more follicular and patchy infiltrated plaques after 3 days
7 6-6-35	Finsen lamp	None	3 minutes, contact	Ultra violet and visible light	None	Erythema beginning about 4 hrs. after irradiation. Maximum with vesiculation after 48 hrs.	Turned into an infiltrated plaque with follicular swelling after 48 hours; healing after about 10 days
8	Same	Schott BG 5	30 minutes, contact	Long ultra-violet, violet and blue light	None	No erythema	No delayed reaction

* Controls on a normal person did not produce any reaction, immediately or delayed, following irradiation with the uviol filtered Kromayer lamp as used in experiment 6.

early as 30 minutes after the irradiation; it was connected with definite itching. However, this early reaction was not of the type of the immediate primary urticarial response. After three to five days, or longer, the erythema would turn into follicular, papular lesions (see fig. 2). The wave lengths responsible for this erythema have not been determined definitely. The "sunburn spec-

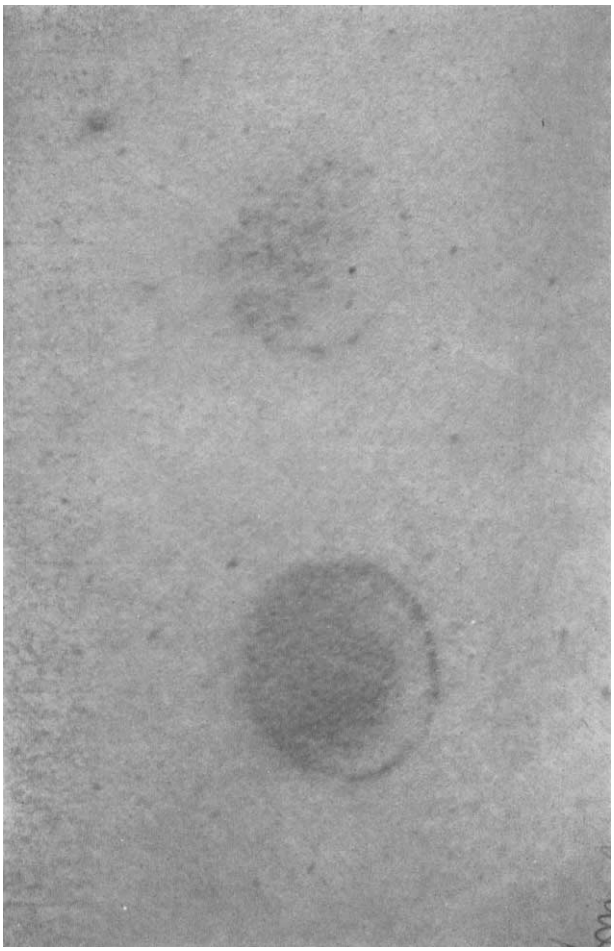

FIG. 2 (TOP). PAPULAR ERUPTION FIVE DAYS AFTER UNFILTERED ULTRAVIOLET IRRIDATION (CASE 3, TABLE 1, EXPERIMENT 2)
FIG. 2 (BOTTOM). MORE CONFLUENT ERUPTION AT SITE OF LONGER EXPOSURE (CASE 3, TABLE 1, EXPERIMENT 3)

trum" seems responsible for those reactions elicited by the unfiltered Kromayer lamp. The severe responses following the blue uviol filtered light point to an action of the longer ultraviolet, as numerous tests on controls have shown that hardly any sunburn radiation passed through this filter on exposures up to one hour. Activity of the blue and violet light seems excluded by the experiments 7 and 8 (table 1).

Case 5. Mr. A. B., a farmer and lumberjack, 35 years of age, suffered from prurigo aestivalis for three years. He presented the typical picture of prurigo aestivalis. The eruption was confined to those parts of the face, neck, jugular triangle and lower two-thirds of the arms which had been exposed to and tanned by the sun (figs. 1 and 2 of part I). He declared definitely that the sun does not bring out an eruption while his condition is improving during the summer months.

FIG. 3. SUNBURN REACTION FOLLOWING BLUE UVIOL FILTERED MERCURY ARC LIGHT
This radiation did not produce a reaction in normal controls (case 3, table 1, experiment 6)

Examination for light sensitivity. The tests were performed on the back of the patient which was free from pathological changes. Contact irradiation with the Kromayer lamp was applied, unfiltered and through blue uviol filter with the following results: 1) No immediate urticarial reactions were elicited. 2) The unfiltered radiation was followed by a normal sunburn reaction corresponding to the applied doses. 3) At the site of the longer exposure prurigo-like papules appeared on the tenth day; they persisted for three to four days.

Case 6. E. F., a boy, 14 years of age, suffered from a prurigo-like skin eruption of the face and arms since he was six years old. It started early in the

TABLE 2

Light tests in case 6

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULT		
					I Immediate reaction	II Sunburn-like reaction	III Provocation of prurigo-like eruption and delayed reaction
1 4-18-35	Kromayer lamp	None	30 seconds, contact	Ultraviolet, blue and violet light	None	Moderate erythema (normal)	On 5th day grouped papulo-vasicular eruption appearing inside of field of irradiation. Disappears within 6 more days
2 4-18-35	Same	None	60 seconds, contact	Same	None	Moderate erythema (normal)	Prurigo-like eruption on fifth day as in experiment 1 (see fig. 4), persisting for about 12 days. About one month later (5-16-35), simultaneously with a spontaneous eruption of the face, following exposure to sun, prurigo papules appeared at and exactly confined to the old site. The same happened again 2 weeks later, simultaneously with another spontaneous flare up of the face
3 4-23-35	Same	None	2 minutes, contact	Same	None	Moderate erythema (normal). Maximum after about 16 hrs.	After 40 hours, a few papular lesions began to appear, which cleared up after about 1 week. On 5-18-41, following a spontaneous flare up of face, a new eruption of 8-10 lesions appeared at the site of the test
4 4-23-35	Hanovian lamp	None	5 minutes, 50 cm.	Same	None	Definite erythema with slight swelling (normal)	After 48 hours, this time, a few papules appeared, lasting about 5 days. Further eruptions, similar to experiment 3 appeared on 5-18-35 and 5-31-35
5 4-18-35 and 4-23-35	Kromayer lamp	Blue uviol	15, 20 and 40 minutes respectively, contact	Long ultra-violet, blue and violet light	None	No erythema	None
6 7-3-35 and 7-5-35 (10 weeks later)	Kromayer lamp	Blue uviol	4-20 minutes, contact	Long ultra violet, violet and blue light	Immediate pigmentation, maximum after 2-5 min. fading after 1 hr.	Slight pigmentation after 24 and 48 hrs.	No further observation after 48 hrs.

TABLE 2—*Continued*

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULT		
					I Immediate reaction	II Sunburn-like reaction	III Provocation of prurigo-like eruption and delayed reactions
7 4–23–35	X-ray tube	0.5 mm. Al equivalent	360 r, 30 cm.	X-rays 100KV 2.0 mm. HVL	None	Slight erythema noticed after 16 hours lasting for 2 weeks, accompanied and followed by pigmentation	Questionable eruption on 5–20–41
8 4–24–35	Mesothorium plaque 1 cm. square, 20 mg. el. radium equivalent	0.1 mm. silver	1⅓ mgh. contact	Beta rays	None	Slight erythema after 24 hours, followed by pigmentation	Around 5–18–35, at the time of a spontaneous flare up, 3 papular lesions appeared
9 4–24–42	Same	1.5 mm. silver	30 mgh. contact	Gamma rays	None	Slight erythema with very little pigmentation after 24 hours. After 1 month bright red erythema (5–23–35)	Similar to experiment 7
10 4–25–35	Thorium X ointment, 2000 electrostatic units in 1 gm.	None	24 hours, contact	Alpha rays	None	Severe erythema with swelling. Maximum on fourth day. Followed by pigmentation persisting for many weeks	On the 7th day, while the erythema was fading, numerous small papular lesions were present within the tested area. 5 weeks later, shortly after a spontaneous flare up of the face, about 12 pinpoint to lentil sized papules appeared; number and size of these lesions increased subsequently, so that they turned into a confluent plaque which covered a large part of the tested area on the 8th day, (see figure 5a) and nearly the whole of it on the 12th day (see fig. 5b.)
11 4–25–35	Thorium X-lacquer, 1500 electro-static units in 1 cc.	None	24 hours, contact	Alpha rays	None	Marked erythema followed by slight pigmentation	On the seventh day, a few papular prurigo-like lesions appeared on the edge of the tested area. At this site the erythema from Thorium X had been more severe

spring, sometimes even in January, and usually lasted until June. The dermatosis recurred usually in November and cleared up around Christmas time. In April 1935, the patient presented a papular, itching dermatitis of the face, chiefly centered on both cheeks, but involving also the forehead, nose and lips. There were no blisters or hydroa-like lesions. Exposure of the face to natural sun was followed by itching and an aggravation of the lesions within one hour.

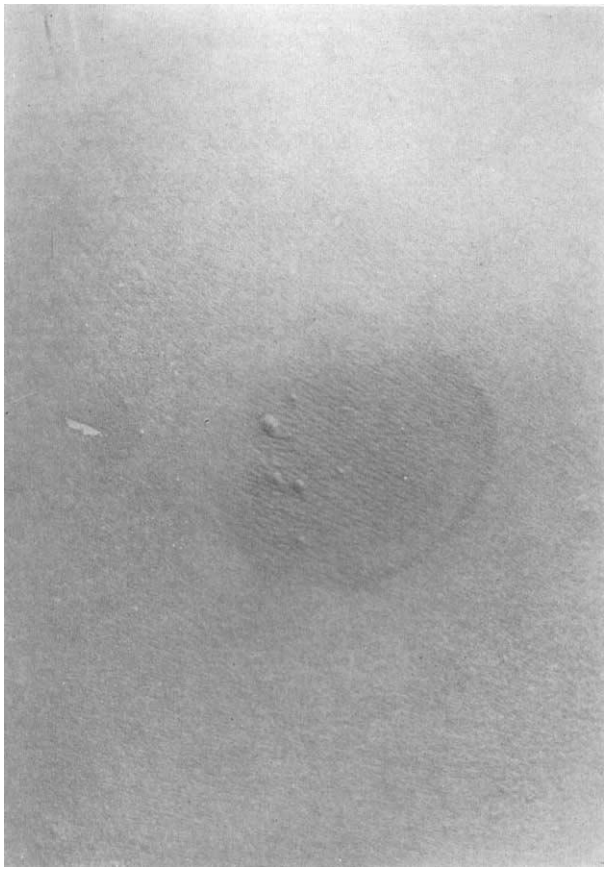

FIG. 4. PRURIGO-LIKE ERUPTION APPEARING AFTER UNFILTERED ULTRA-VIOLET IRRIDATION (CASE 6, TABLE 2, EXPERIMENT 2)

After 10 to 12 hours, new lesions appeared on the nose. At the same time, a few papules occurred on the extremities and the body, some even on parts not exposed to the light.

The light tests were performed on the previously not affected back of the patient; the results are given in table 2.

Conclusions of light tests in case 6. 1) No urticarial reactions were noted. An immediate pigmentary reaction following blue uviol filtered mercury arc light was observed in several experiments, but not at all times; it was mani-

fested by a grayish pigmentation which appeared after a few minutes and disappeared within 24 to 48 hours.

This immediate pigmentation, also demonstrated in case 1, is not without parallels in the literature; a few similar observations have been reported in hydroa vacciniformis (Epstein (b)). It seems probable that this reaction will be found connected with those wavelengths which have lately been shown to produce immediate pigmentation (Schulz and Henschke, Miescher and Minder). Whether the observation in case 6 points to a hypersensitivity to these spectral regions, I would not venture to state. In this case it would just add another form of light sensitivity. 2) The sunburn reaction was normal on previously not affected skin. 3) Prurigo-like reactions were elicited on previously not involved areas by ultraviolet rays after an incubation period of five days in the

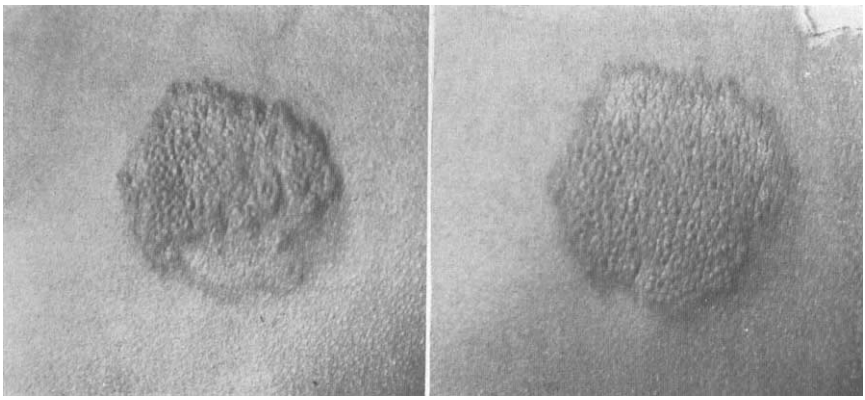

FIG. 5a FIG. 5b

FIG. 5a. MORE OR LESS CONFLUENT PAPULAR ERUPTION APPEARING AT SITE OF FORMER ALPHA RAY ERYTHEMA (CASE 6, TABLE 2, EXPERIMENT 10)
FIG. 5b. SAME EXPERIMENT, FOUR DAYS LATER; THE ERUPTION NOW COVERS NEARLY ALL OF THE TESTED AREA

first experiments (see fig. 4). This interval was shortened to two days in the subsequent experiments (table 2, experiments 1 to 4). A similar eruption followed erythem produced by alpha rays. Flare-ups of the original eruption were accompanied by the appearance of prurigo-like nodules at the sites of previous tests with ultraviolet and other radiations (see fig. 5).

Case 10. Mrs. H. S., a housewife, 33, suffered from a skin eruption from sunlight since about 1924. About one-half hour after exposure to sun, the patient noticed itching and burning of the skin of the non-covered parts of the body. This was followed by erythema and a blistering, later crusted dermatitis of the face and hands. The patient believed that the sensitivity of the exposed parts disappeared around the end of May; after that time she might expose face and hands to the sun with impunity, but not those parts of the body which previously had been protected by clothes.

TABLE 3
Light tests in case 16

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULT		
					I Immediate reaction	II Sunburn-like reaction	III Provocation of prurigo-like eruption and delayed reactions
5-20-35 2 experiments	Kromayer lamp	None	15 and 30 sec. respectively, contact	Short and long ultraviolet, blue and violet light	Slight immediate erythema	Severe sunburn erythema, maximum with swelling and vesiculation on third day. Pigmentation lasting for more than 2 months	No prurigo eruption
2 5-20-35	Same	None	1 minute, contact	Same	Immediate urticarial reaction	Severe pathological sunburn erythema similar but still more pronounced than in experiment 1	No immediate prurigo eruption; 6 weeks later, however, simultaneously with spontaneous recurrence of light dermatitis, prurigo-like lesions appeared at this site
3 5-20-35	Hanovian lamp	None	3 minutes, 50 cm.	Same	Same	Severe pathological sunburn reaction similar to experiments 1 and 2	No prurigo eruption
4 5-22-35	Kromayer	Blue uviol	10 minutes contact	Long ultraviolet, violet and blue light	Immediate urticarial reaction measuring 4.2 x 4.5 cm., size of irradiated field 3.5 x 3.7 cm.	Mild sunburn erythema, appearing after 4 hours; after 48 hrs. slight pigmentation	No prurigo eruption
5 5-22-35	Finsen	None	3 minutes, contact	Short and long ultraviolet and visible light	Immediate slightly urticarial reaction with pruritus	Red sunburn erythema with slight swelling. Maximum after 48 hrs.	No prurigo eruption
6 5-23-35	Finsen	Schott BG5	30 and 60 minutes respectively, contact	Long ultraviolet blue and violet light	Immediate urticarial reaction	No sunburn erythema	No prurigo
7 5-22-35	Thorium X ointment	None	12 hours, contact	Alpha rays	No immediate reaction	Mild erythema, appearing after 24 hrs. Maximum after about 3 weeks	No prurigo

TABLE 3—*Continued*

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULT		
					I Immediate reaction	II Sunburn-like reaction	III Provocation of prurigo-like eruption and delayed reactions
8 7-22-35 (2 months later)	Kromayer lamp	None	15 seconds, contact	Short and long UV, blue and violet light	No immediate reaction (see figure 6a, left side)	Severe pathological sunburn reaction with swelling and pruritus (see fig. 6, b, left side)	No further observation after 48 hrs.
9 7-22-35	Same	Blue uviol	10 minutes, contact	Long UV, and violet light	Immediate urticarial reaction (see figure 6 a right side)	Slight erythema after 24 hrs. without swelling and pruritus (see figure 6 b, right side). After 48 hrs. nearly gone	Same

Light tests performed on normal skin with the unfiltered Kromayer and Finsen lamps, showed increased sensitivity to the sunburn radiation. Doses which elicited in normal controls only a slight erythema, subsiding after twenty-four hours, led to a severe dermatitis like reaction on the patient's back. It appeared about 75 minutes after the irradiation and was accompanied by itching and burning.

Case 16. Mrs. H. St., a housewife, age 41. Her sensitivity to light was first noticed at age 4. Exposure to the sun caused burning, followed by redness, urticarial swelling, and sometimes even vesiculation. In the beginning the face only was involved; later on the eruption appeared also on the arms, neck and jugular triangle. The condition improved spontaneously after her twelfth year. No eruption occurred in 1926, even upon exposure to sun. With that exception, the eruption appeared every year. It was especially bad in 1935. An acute dermatitis of the face with swelling and inflammation followed exposure to the sun while hiking along a river early in May. When the dermatitis subsided, numerous pin-head sized papules appeared on top of the erythematous base. No varioliform lesions were noted. The eruption of the arms was prurigo-like; some confluent lesions resembled the picture of neurodermitis.

The light tests were performed on the patient's back; the results are presented in table 3.

Conclusions of light tests in case 16. 1) Immediate urticarial reaction probably provoked by violet and blue light (see fig. 6a, right side) 2) Severe hypersensitivity to sunburn radiation, manifested by intensive dermatitis. 3) No provocation of prurigo at time of light test; but appearance of prurigo lesions at one test site 6 weeks later, simultaneously with spontaneous flare-up (experiment 2).

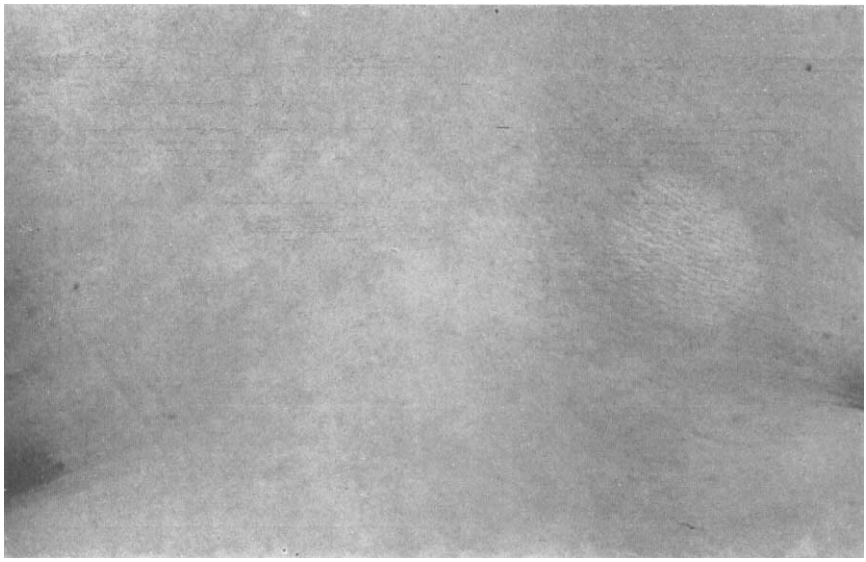

FIG. 6a. RIGHT SIDE: IMMEDIATE URTICARIAL REACTION FOLLOWING UVIOL FILTERED MERCERY ARC RADIATION (CONTROLS SHOWED NO REACTION). LEFT SIDE: NO IMMEDIATE REACTION AT SITE OF UNFILTERED IRRIDATION (CASE 16, TABLE 3, EXPERIMENTS 8 AND 9)

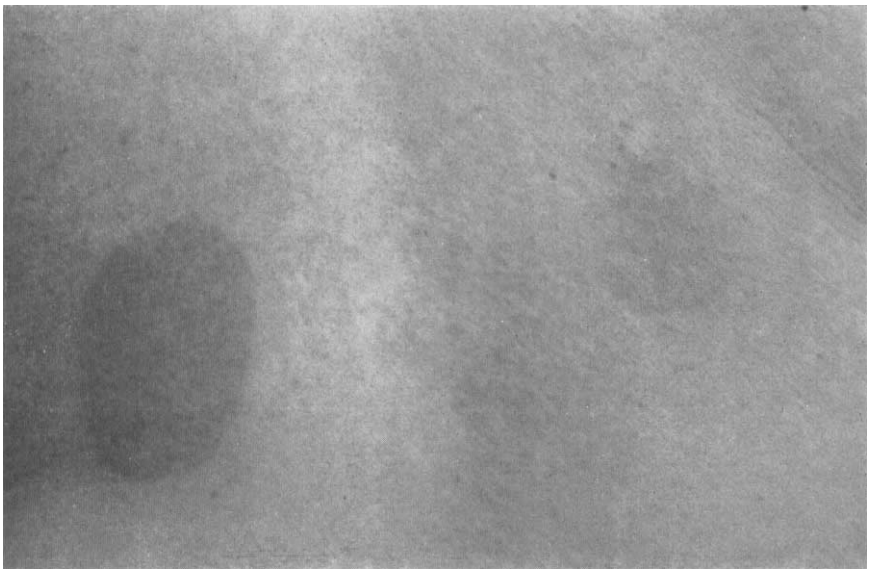

FIG. 6b. SAME EXPERIMENT, 24 HOURS LATER

Right side: The uviol filtered light produced a slight erythema, (controls showed no reaction). Left side: The unfiltered radiation of only 15 seconds produced a pathological, severe sunburn with pruritus (controls showed only a slight erythema).

Case 17. Miss M. K., a stenographer, age 31, suffered from urticaria photogenica for about ten years. In the last two years the attacks would occur more

TABLE 4

Light experiments in case 17

1 NUMBER OF EXPERIMENT AND DATE	2 SOURCE OF RADIATION	3 FILTER	4 TIME OF IRRADIATION AND DISTANCE	5 EFFECTIVE RADIATION	6 RESULT		
					I Immediate reaction	II Sunburn-like reaction	III Provocation of prurigo-like eruption and delayed reactions
1 6–19–33	Sun	Window glass	Several minutes	Long ultraviolet and visible light	Immediate urticarial reaction	No erythema	No delayed reaction
2 6–19–33	Kromayer lamp	None	30 seconds, contact	Short and long ultra-violet, blue and violet light	Slight immediate erythema appearing after 15 minutes	Light erythema (normal)	No delayed reaction
3 6–19–33 2 experiments	Same	None	60 seconds, contact, and 7 min. at 5 cm. distance, respectively	Same	After 2 minutes erythema, followed immediately by itching and whealing. Wheal lasts 2 hrs.	Sharply outlined erythema	No delayed reaction
4 8–21–33 (2 months later)	Same	None	60 seconds, contact	Same	Similar but less pronounced reaction than in experiment 3	No further observation	No further observation
5 6–19–33	Same	Blue uviol glass	5 minutes, contact	Long ultraviolet, violet and blue light	Slight erythema after 10–30 min.	No sunburn erythema	No delayed reaction
6 6–19–33	Same	Same	10 minutes, contact	Same	Immediate erythema with pruritus, followed by whealing. Wheal disappeared after 2 hrs.	Trace of erythema after 24 hrs., gone after 48 hrs.	Same
7 6–20–33	Kromayer lamp	Wood filter	40 minutes, contact	3600 Å + long ultra violet	No immediate reaction	No erythema	No delayed reaction
8 6–19–33	Finsen lamp	Schott BG5	15 minutes, contact	Long ultraviolet, blue and violet light	Immediate erythema, followed by definite, though slight whealing	No sunburn erythema	Same
9 8–23–33 (2 months later) 3 experiments	Same	Same	15, 30 and 60 minutes, respectively	Same	No immediate reaction	No further observation	No further observation
10	Thorium X ointment	None	24 hours, contact	Alpha rays	No immediate reaction	Normal erythema	No delayed reaction
11	Mesothorium plaque, 1 cm. square, 20 mg. radium equivalent	0.3 mm. silver	25 minutes	Beta rays	No immediate reaction	Normal erythema	No delayed reaction

frequently, also in winter and even with relatively short exposure to the sun. Early in summer, the urticaria appears in increased strength, but subsides afterward when the skin gets used to the summer sun. While in the mountains, the patient does not suffer from the condition. Only the parts exposed to the sun are affected. When wearing light dresses and stockings, urticaria may appear on the rest of the body including her feet. The urticaria is accompanied by burning and itching. During 1935 the patient suffered twice from a severe dermatitis of the face following exposure to the sun. This dermatitis cleared up without pigmentation and did not turn into a prurigo-like eruption. On the patient's arms, however, nodules occurred during the summer which clinically and microscopically presented the picture of prurigo.

This case presented clinically a combination of urticaria photogenica with eczema solare and prurigo aestivalis. The light tests were performed on the back of the patient, the results are presented in table 4.

Conclusions of light tests in case 17. 1) Immediate urticarial reactions were produced by violet and blue light. Ultraviolet rays possibly played also a role. This was indicated by two observations: Unfiltered mercury arc light—unlike in case 16—produced an immediate whealing reaction. Repetition of the experiments two months later produced again an urticarial reaction with unfiltered ultraviolet, but not with blue filtered carbon arc light. 2) The sunburn reactions were not excessive. 3) No prurigo-like lesions appeared at the tested parts.

DISCUSSION AND COMMENTS

Classifications of pathological skin reactions to light are not satisfactory as yet. The differentiation has been based on etiological, biological, physical or morphological criteria, none of which satisfies in all instances. An etiological approach will be attempted later in part IV. In discussing the clinical forms of pathologic sensitivity to light, a classification based on morphologic criteria seems more adequate at this juncture.

Morphologically the following three types of pathological reactions to light are distinguished: 1. Immediate urticarial (whealing) reaction. 2. Pathological sunburn-like reactions. 3. Provocation of specific lesions.

(1) *Immediate urticarial reaction.* This reaction, never observed in normal individuals, starts as an erythema which develops within a few minutes after the beginning of the irradiation. It is usually accompanied by pruritus. With short exposures such an erythema, lasting from 15 to 60 minutes, may be all that occurs. Upon longer irradiation a more or less urticarial lesion with an erythematous flare appears, the intensity and duration of which corresponds to the length of exposure. Using small doses, only a part of the tested area may show urticarial swelling, whereas adequate exposure is followed by a complete wheal which exceeds the tested site for a few millimeters (see fig. 6a, right side).

It is evident that an immediate urticarial reaction to light can be produced in all cases of urticaria photogenica. In the one instance of a pure urticaria photogenica in my series (case 11), the urticaria could be provoked by window filtered light, but not by heat. This could mean a sensitivity to blue and violet

but also to the other visible light or the longer ultraviolet. In the two instances of urticaria solaris combined with other forms of light sensitivity (cases 16 and 17) the urticarial reaction definitely could be produced by blue and violet light (4000 to 4800 Å); in case 17 ultraviolet also seems to have elicited the urticarial response.

The wavelengths responsible for an immediate urticarial reaction are not identical in all cases: blue and violet rays in some, ultraviolet shorter than 3200 Å in others.[3] This indicates etiological differences; it points to a variety of sensitizers, as in all probability the action spectrum corresponds to the absorption spectrum of these hypothetical substances. But until we know more about these phenomena, I do not feel justified to separate urticaria due to violet and blue light principally from that due to other wavelengths; at least not any more than we distinguish between urticaria from milk and that from oysters.

2) *Pathologic sunburn-like reactions.* They are distinguished chiefly quantitatively from the normal ultraviolet reaction. Reactions of this type have been reported by several authors in cases which belong to the prurigo aestivalis group (Barber, et al; Greenbaum; O'Leary and Goeckerman; Templeton and Lunsford; Blum (a)). In my series 4 patients exhibited a severe pathological reaction of that type (cases 3, 9, 10 and 16). Negative results have been reported by others. Various reasons may account for them. The source of light may not have contained enough of the responsible wavelengths. The tested site may not have been sensitive, or the patient's sensitivity may have been lost or decreased at the time of the test.

3) *Production of lesions characteristic of the particular disease.*[4] *Experimental production of prurigo-like lesions.* The production of prurigo-like lesions by irradiation has been reported by numerous authors (Sellei and Liebner; Urbach and Konrad; Schaumann and Lindholm; Touraine; Turner; Blum (a); Sonck; Haxthausen). Schaumann and Lindholm noted prurigo lesions a few hours following irradiation with the wavelength 3020 Å. In *Turner's* case prurigo nodules appeared seven hours following filtered ultraviolet irradiation. Sellei and Liebner performed numerous tests on diseased and normal skin in prurigo aestivalis. The observations in my cases substantiate partly these findings and furnish further information.

The observations and experiments of these authors as well as mine, regarding provocation of prurigo aestivalis, may be summarized as follows:

A. *Irradiation of previously diseased skin may lead to:* a) Local provocation of prurigo within a few hours. b) Provocation of prurigo on other previously diseased or tested, but not irradiated parts (see case 6). c) No prurigo eruption on previously not diseased parts.

[3] The literature on this subject has been reviewed recently by Blum (a) and by Epstein (a).

[4] The shortcomings of our classification become apparent here. The production of urticaria like lesions in urticaria photogenica has been discussed under no. 1. Eczematous reactions have been dealt with under no. 2, as there is no definite difference between a severe sunburn and a dermatitis.

B. *Irradiation of normal skin, previously not diseased, may lead to:* a) No eruption on irradiated parts (see case 16). b) Prurigo eruption after 5 to 9 days (see case 5 and case 6, experiment 2). C) Prurigo eruption after 2 to 4 days (see case 6, experiments 3 and 4). d) Prurigo eruption at previously diseased but not irradiated site.

Some of my experiments as well as observations of others indicate, that the provocation of lesions of prurigo aestivalis may not be only a problem of specific absorption of certain wavelengths. Local provocation on previously normal skin was always dependent on the provocation of an erythema. Without erythema, no prurigo appeared. The intensity of the eruption increased directly in proportion to the degree of the erythema (see case 5 and table 2, experiment 1, 2, 3, 10 and 11). This erythema was not necessarily due to ultraviolet. Erythema from other radiation, such as alpha rays, had the same result. That an erythemic[5] effect is necessary becomes apparent from those instances where the prurigo eruption was provoked by normally not erythema producing radiation. Yellow-red light was responsible in Urbach and Konrad's report. These rays however produced an erythema in this case. The provocation of lesions by erythema from radiations other than ultraviolet has its parallel in other light sensitive dermatoses. I shall recall in this respect the provocation of hydroa vacciniformis through alpha rays (Epstein (b)).

CONCLUSIONS AND SUMMARY

1. In that group of light diseases, which consists of urticaria photogenica, eczema solare, prurigo aestivalis, and their combinations, at least three different types of sensitivity to light have been demonstrated: a) Immediate urticarial (whealing) reaction. b) Pathological sunburn-like reaction. c) Provocation of specific lesions of prurigo.

2. These three manifestations of hypersensitivity to light seem independent of each other; they correspond essentially to the clinical entities of urticaria photogenica, eczema solare and prurigo aestivalis.

3. In cases which clinically represent combinations of the different types, more than one and even all three forms of light sensitivity have been found; thereby explaining the variety of clinical manifestations.

4. The results of the light tests need not parallel at all times the clinical manifestation of a patient suffering from multiple forms of light sensitivity.

5. The three forms of light sensitivity are not due to specific wavelengths. Every one of them has been provoked by more than one spectral region.

6. The difference between the immediate urticarial response and the pathological sunburn reaction is generally recognized; the separation of the latter from the provocation of prurigo-like lesions is just as fundamental, although both forms of sensitivity may be observed together in the same person.

[5] The term "erythemic" radiation (Coblenz) includes here all those radiations which elicit an erythema of the sunburn or x-ray reaction type. I prefer it to the more correct term "erythematogenic" radiation (J. A. M. A. **116**: 705, 1941).

7. Prurigo lesions may be provoked experimentally in patients who present a normal reaction to sunburn radiation. This phenomenon is not dependent on sunburn radiation (= ultraviolet shorter than 3200 Å). It appears only when a marked radiation erythema has been produced; but its source is not necessarily the sunburn spectrum. Erythemas from other radiation, such as alpha rays, also have been followed by prurigo lesions.

8. The etiological significance of this form of reaction will be discussed in part 4 of these papers.

References will be found after part IV